

## PALAEONTOLOGICAL HERITAGE ASSESSMENT: DESKTOP STUDY

# Proposed Residential Development on a Portion of Erf 155, Keurboomstrand near Plettenberg Bay, Eden District Municipality, Western Cape Province

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## 1. EXECUTIVE SUMMARY

Ferpa (Pty) Ltd is proposing to construct a residential development with associated infrastructure on a Portion of Remainder of Erf 155 (5.6 ha in extent), Keurboomstrand, situated on the Southern Cape coast c. 10 km northeast of Plettenberg Bay in the Eden District Municipality, Western Cape Province.

The project area for the proposed residential development is underlain by Late Silurian to Early Devonian marine to coastal sediments of the Baviaanskloof Formation (uppermost Table Mountain Group). Elsewhere along the Southern Cape coast dark, organic-rich mudrocks of possible lagoonal origin within this formation contain important, largely unstudied fossils of primitive land plants while a small range of shelly invertebrate and trace fossils occur within shallow marine sandstone facies in parts of the Western Cape. The overlying Late Caenozoic superficial sediments (colluvium, coversands, soils etc) are probably largely or entirely unfossiliferous.

The DEFF Screening Tool does not highlight the potentially high palaeosensitivity of the Keurboomstrand residential development project area while this is assigned a MEDIUM sensitivity on the SAHRIS Palaeosensitivity Map. However, given (1) the demonstrated presence of dark grey mudrocks of the Baviaanskloof Formation, both at surface and within test pits within the project area, and (2) the potential of these mudrocks to contain scientifically valuable fossils, most notably primitive terrestrial plants, a precautionary approach is appropriate here. **Pending a specialist palaeontological site visit, the bedrocks should be provisionally assigned a HIGH to VERY HIGH palaeosensitivity.**

**As a condition for Environmental Authorisation of the proposed development, it is recommended that a pre-construction site visit be made by a palaeontological specialist.** This is to (1) record any near-surface fossil material and its geological context, (2) assess the site's palaeosensitivity and potential impacts on fossil heritage posed by the development, and (3) make appropriate recommendations for any further palaeontological monitoring or mitigation measures (if any) to be taken in the pre-construction and / or construction phases. The specialist palaeontological field report should be submitted for comment to Heritage Western Cape (HWC contact details: Heritage Western Cape, Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za). All reporting should meet the minimum standards for palaeontological reports specified by HWC (2016).

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## 2. INTRODUCTION & BRIEF

The company Ferpa (Pty) Ltd is proposing to construct a residential development with associated infrastructure (*viz.* c. 60 m access road, water supply, sewerage storage, electricity supply, rainwater harvesting and stormwater management) on a Portion of Remainder of Erf 155 (5.6 ha in extent), Keurboomstrand, situated on the Southern Cape coast some 10 km northeast of Plettenberg Bay in the Eden District Municipality, Western Cape Province (Figs. 1 & 2). The proposed site layout (preferred option with 3 units) is shown in Figure 3.

The application for Environmental Authorisation for the housing development is being conducted on behalf of the proponent by Bluepebble Sustainability Solutions, Knysna (Contact details: Mr Jonathan Kingwill, Bluepebble Sustainability Solutions. Postnet Suite 41, Private Bag X31, Knysna, 6570. Tel: +27 (82) 777 0705. Fax: +27 (86) 553 8837. E-mail: jonathan@bluepebble.biz). A Heritage Statement for the development prepared by Dr Peter Nilssen, Mossel Bay (Nilssen 2020) illustrated potentially fossiliferous shales on adjoining Erven 155 and 391, as also shown in the relevant geotechnical report by Outeniqua Geotechnical Services (2020), and drew attention to the Moderate Palaeosensitivity of the project area on the SAHRIS Website. A desktop palaeontological study (PIA) for the residential project was therefore recommended and has accordingly been commissioned by Bluepebble Sustainability Solutions.



**Figure 1: Extract from topographical sheet 3322 Oudtshoorn (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the proposed residential development on a Portion of Remainder of Erf 155 Keurboomstrand, situated along the south coast c. 10 km northeast of Plettenberg Bay, Eden District Municipality, Western Cape Province (blue dot).**





Figure 2: Satellite image showing the boundary of the Remainder of Erf 155 (purple polygon) and the approximate project area of the proposed nearshore residential development at Keurboomstrand (Image abstracted from the Geotechnical Report by Outeniqua Geotechnical Services 2020).

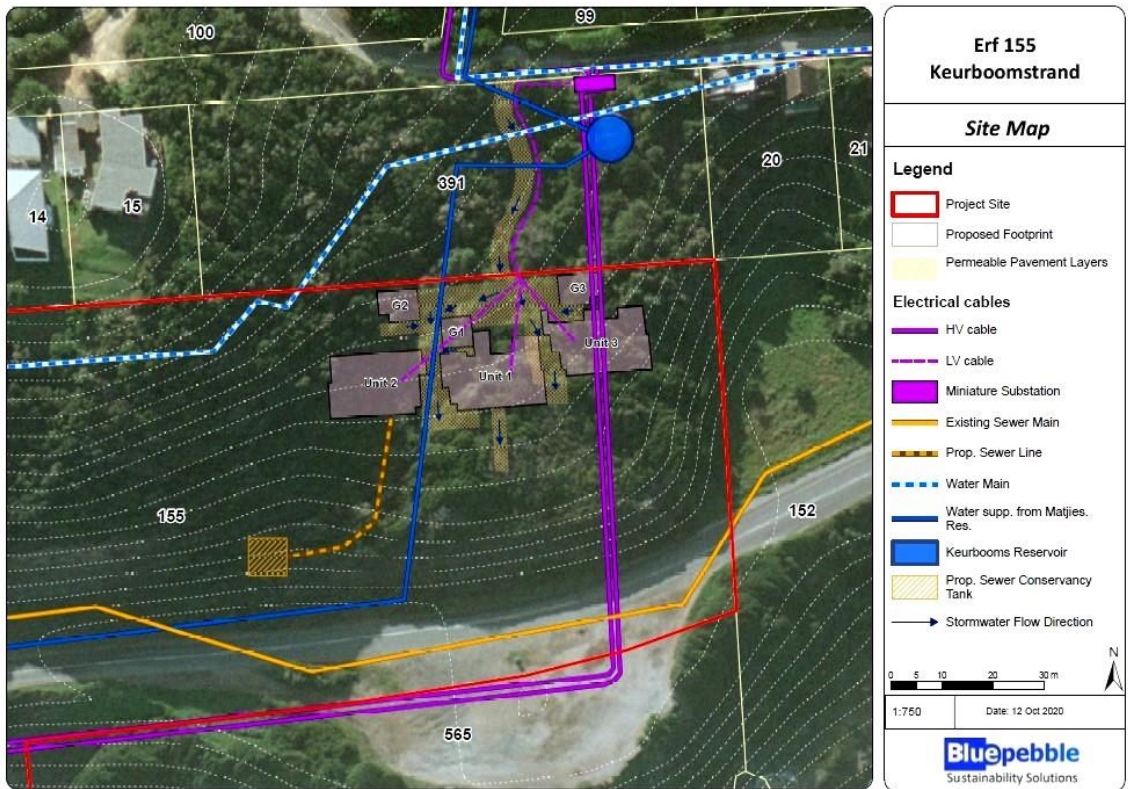


Figure 3: Satellite image showing the preferred layout of the Keurboomstrand residential development (Image provided by Bluepebble Sustainability Solutions).

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## 2.1. Approach used for this palaeontological impact study

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act, 1999, include, among others:

- geological sites of scientific or cultural importance
- palaeontological sites
- palaeontological objects and material, meteorites and rare geological specimens

This PIA report provides an assessment of the observed or inferred palaeontological heritage within the residential development project area at Keurboomstrand, with recommendations for specialist palaeontological mitigation where this is considered necessary.

The report is based on: (1) a review of the relevant scientific literature, including previous fossil heritage studies of comparable sedimentary rocks in the Western and Eastern Cape (e.g. Almond 2005, 2012, 2013, 2019), (2) published geological maps (1: 250 000 sheet 3322 Oudtshoorn) and accompanying sheet explanations (e.g. Toerien 1979), (3) the well-illustrated Heritage Statement and Geotechnical Report for the residential development by Nilssen (2020) and Outeniqua Geotechnical Services (2020) respectively, and (4) the author's extensive field experience with the formations concerned and their palaeontological heritage (*cf* Almond & Pether 2008).

The approach to this palaeontological heritage study is briefly as follows. Fossil bearing rock units occurring within the broader study area are determined from geological maps and satellite images. Known fossil heritage in each rock unit is inventoried from scientific literature, previous assessments of the broader study region, and the author's field experience and palaeontological database. Based on this data as well as field photos of representative exposures of the major sedimentary rock units present presented in the reports by Nilssen (2020) and Outeniqua Geotechnical Services (2020), the impact significance of the proposed development is addressed with recommendations for any further studies or mitigation. The likely impact of the proposed development on local fossil heritage is dependent on (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint (as here), a Phase 1 field assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any monitoring or mitigation required before or during the construction phase of the development. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (e.g. sedimentological data) may be required (a) in the pre-construction phase where important fossils are already exposed at or near the land surface and / or (b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a Palaeontological Collection Permit from the relevant heritage management authorities, *i.e.* Heritage Western Cape (Contact details: Heritage Western Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za). It should be emphasized that, *providing appropriate mitigation is carried out,*

the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

## 2.2. Legislative context for palaeontological assessment studies

The proposed residential development is located in an area that is underlain by potentially fossiliferous sedimentary rocks of Palaeozoic and younger, Late Caenozoic age (Sections 3 and 4). The proposed development will entail substantial excavations into the superficial sediment cover and the underlying bedrock as well. This development may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils preserved at or beneath the surface of the ground that are then no longer available for scientific research or other public good.

The present combined desktop and field-based palaeontological heritage study falls under the South African Heritage Resources Act (Act No. 25 of 1999). It will also inform the Environmental Management Programme (EMPr) for this residential project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

- (1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- (2) All archaeological objects, palaeontological material and meteorites are the property of the State.
- (3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
- (4) No person may, without a permit issued by the responsible heritage resources authority—
  - (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
  - (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
  - (c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
  - (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- (5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
  - (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

- (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
- (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- (d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by HWC (2016) and SAHRA (2013).

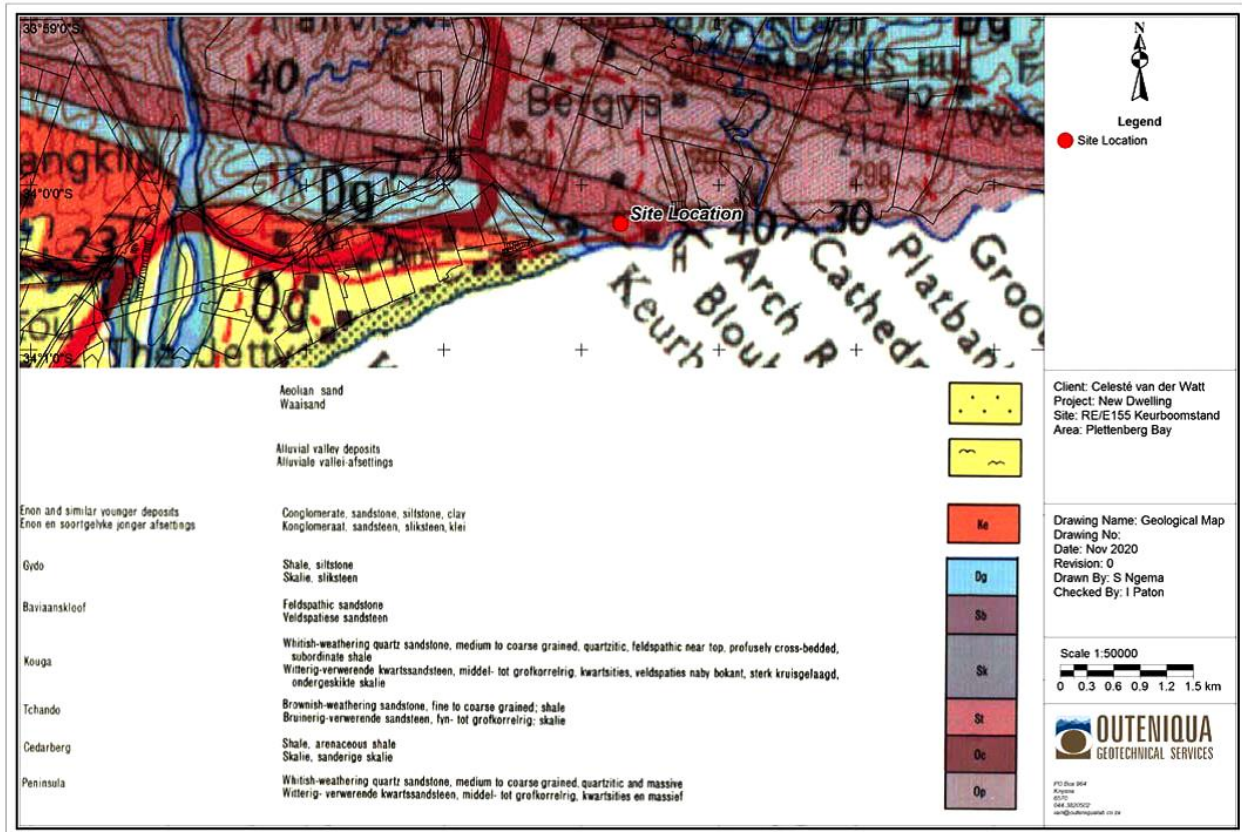
### 3. GEOLOGICAL CONTEXT

The residential project area on a portion of Remainder of Erf 155 at Keurboomstrand is situated on an elevated, densely-vegetated, south-facing slope with good bedrock exposure along the coastal road along its southern edge (Illustrations in Geotechnical Report by Outeniqua Geotechnical Services 2020 and Heritage Statement by Nilssen 2020). The geology of the residential project area is shown on 1: 250 000 geology sheet 3322 Oudtshoorn (Council for Geoscience, Pretoria) with a brief sheet explanation by Toerien (1979) (Fig. 4). The site is situated on the southwestern limb of a prominent-weathering, narrow anticlinal ridge of Table Mountain Group (TMG) bedrocks with a WNW-ESE fold axis. The TMG ridge is flanked on both sides by Early Devonian mudrocks of the Gydo Formation (basal Bokkeveld Group) that are more recessive weathering and therefore build low-lying terrain along the south coast. The project site is underlain by interbedded feldspathic sandstones and subordinate shaly mudrocks of the Late Silurian to Early Devonian **Baviaanskloof Formation** (Table Mountain Group, Nardouw Subgroup; Fig. 6) which are well-exposed in local road cuttings as well as nearby coastal cliffs and along the rocky shoreline to the south (Figs. 2 & 5). Patches of platy, weathered greyish shale as well as thin, recessive-weathering shaly interbeds are seen locally at surface, while fresher-looking mudrocks are exposed within test pits within the project area (*ibid.*). The level of cleavage development within mudrocks associated with tight anticlinal folding is uncertain.

The **Baviaanskloof Formation** is typically less clean-washed than the older subunits of the Nardouw Subgroup, with a higher proportion of lithic grains and clay minerals giving darker hues and more recessive weathering patterns (*cf* Hill 1991, Almond 2013). Sandstones are often (but not invariably) greyish, impure wackes and may be massive or ripple cross-laminated. Dark grey to black carbonaceous and micaceous mudrock intervals are quite common but in general are rarely well exposed (A c. 15 m-thick band of micaceous shale within the upper Baviaanskloof Formation in the Gamtoos area is mentioned by Haughton *et al.*, 1937, for example). The heterolithic “passage beds” of the Baviaanskloof Formation incorporate the sedimentary transition between the fluvial-dominated lower units of the Nardouw Subgroup and the marine shelf sediments of the Lower Bokkeveld Group (Fig. 6). Locally abundant shelly fossils such as articulate brachiopods, trace fossils as well as wave ripple lamination demonstrate the shallow marine origins of at least some of the upper sandstones, while the dark mudrocks with dense mats of vascular plant remains may be lagoonal in origin (See Section 4).



According to the illustrated field-based reports by Outeniqua Geotechnical Services (2020) and Nilssen (2020), the steeply SW-dipping bedrocks in the project area are locally overlain by **alluvial and/or colluvial silty sand, gravel and cobbles**. These younger, unconsolidated Late Caenozoic superficial sediments might also, at least in part, represent elevated coastal gravels and “**coversands**” of probable Pleistocene age that are mapped extensively in the Plettenberg Bay area (See discussion and references in Almond 2019).



**Figure 4:** Extract from 1: 250 000 geology sheet 3322 Oudtshoorn (Council for Geoscience, Pretoria, 1979) showing the location of the proposed residential development on a Portion of Remainder of Erf 155 Keurboomstrand, situated c. 10 km northeast of Plettenberg Bay, Eden District Municipality, Western Cape Province (red dot) (Image abstracted from the Geotechnical Report by Outeniqua Geotechnical Services 2020).

The main geological units mapped in the Keurboomstrand region include:

#### TABLE MOUNTAIN GROUP

Baviaanskloof Formation (Sb, dark purple)

Goudini Formation (St, mid-purple) (previous known as the Tchando Formation)

#### BOKKEVELD GROUP

Gydo Formation (Dg, pale blue)

#### UITENHAGE GROUP

Undifferentiated (Ke, orange)

Pleistocene cover sands (pale yellow with black dots) shown on the geological map near Plettenberg Bay to the west may also extend into the project area.



**Figure 5: SW-dipping, interbedded feldspathic sandstones / wackes and shaly mudrocks of the Late Silurian to Early Devonian Baviaanskloof Formation (uppermost Table Mountain Group) exposed in steep hillslopes bordering the residential development project area along its southern margins (Image abstracted from the Geotechnical Report by Outeniqua Geotechnical Services 2020).**



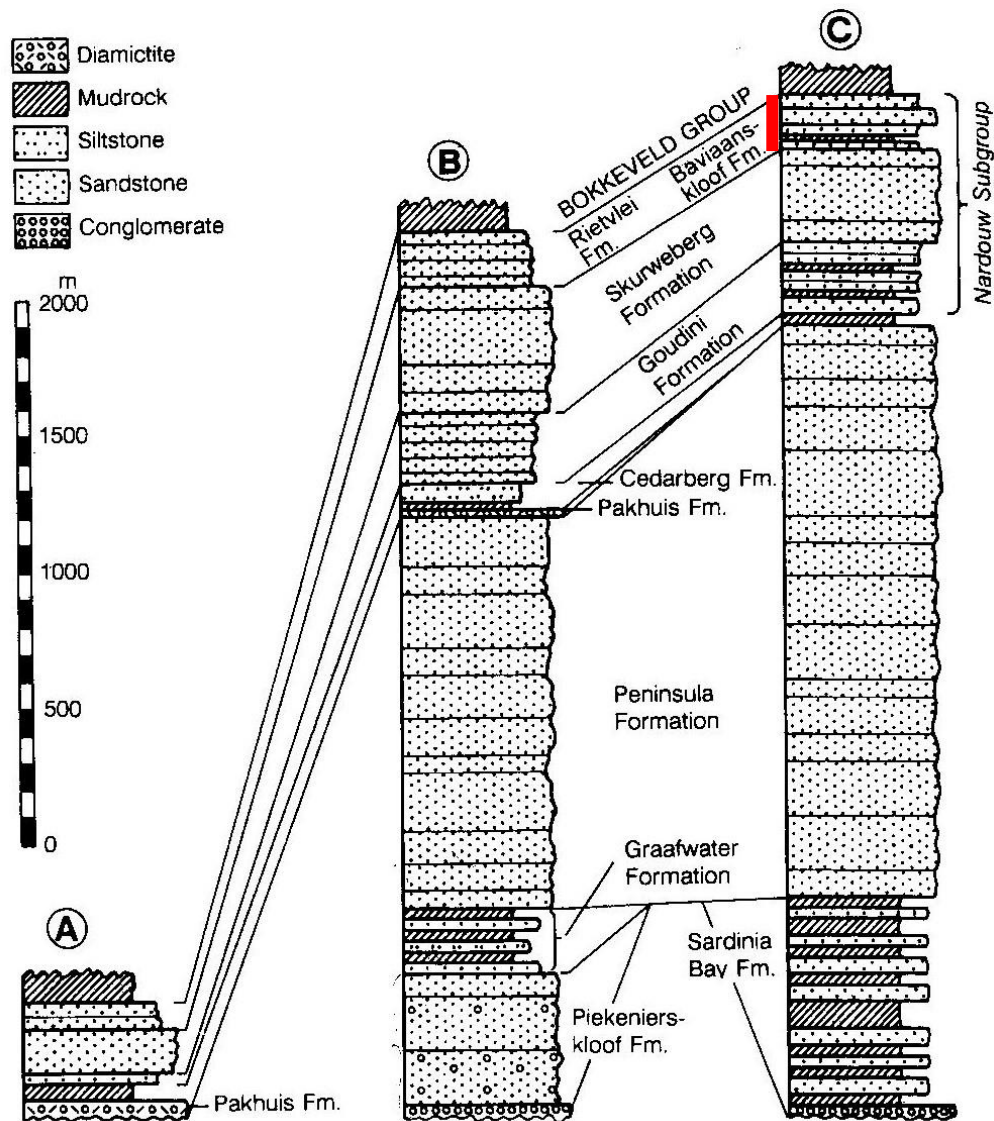


Figure 6: Stratigraphic columns for the Table Mountain Group showing succession of eight constituent formations in the Western Cape (from Johnson *et al.* 1999). Column C, measured to the northeast of Plettenberg Bay, is most relevant to the present study area. The potentially fossiliferous Late Silurian to Early Devonian Baviaanskloof Formation of the Nardouw Subgroup (vertical red bar) underlies the residential development project area.

#### 4. PALAEOLOGICAL HERITAGE

A distinctive marine shelly invertebrate faunule of Early Devonian, Malvinokaffric aspect characterises the upper, marine-influenced portion of the **Baviaanskloof Formation** from the Little Karoo eastwards along the Cape Fold Belt (Almond 2005, 2013, Hill 1991). It is dominated by the globose, finely-ribbed articulate brachiopod *Pleurothyrella africana*. Rare homalonotid trilobites, a small range of articulate and inarticulate brachiopods, nuculid and other bivalves, plectonotid “gasteropods” and bryozoans also occur within impure brownish-weathering wackes (Boucot *et al.* 1963, Rossouw *et al.* 1964, Johnson 1976, Toerien & Hill 1989, Hill 1991, Theron *et al.* 1991, Almond *in* Rubidge *et al.* 2008). In many cases fossil shells are scattered and disarticulated, but *in situ* clumps of pleurothyrellid brachiopods also occur. This shelly assemblage establishes an Early Devonian (Pragian / Emsian) age for the uppermost Nardouw Subgroup, based on the

mutationellid brachiopod *Pleurothyrella* (Boucot *et al.* 1963, Theron 1972, Hiller & Theron 1988). Trace fossils include locally abundant, mud-lined burrows (*Palaeophycus*, *Rosselia*) and rare giant rusophycid burrows of Devonian aspect (*R. rhenanus*) which are attributed to homalonotid trilobites. Dense assemblages of primitive terrestrial vascular plants with forked axes and conical terminal reproductive structures that are provisionally ascribed to the genus *Dutoitia* have been collected from Baviaanskloof Formation mudrocks of possible lagoonal facies near Cape St Francis and at other localities in the Eastern Cape (Dr Mark Goedhart, Council for Geoscience, Port Elizabeth, pers. comm., 2008; Robert Gess pers. comm., 2011; *cf* Hoeg 1930, Anderson & Anderson 1985) (Fig. 8). These are of special palaeobotanical interest since they are among the oldest vascular macroplant remains recorded from southern Africa. Closely comparable material of *Dutoitia* has recently been described from Early Devonian lagoonal sediments in the Paraná Basin of Brazil (Gerrienne *et al.* 2020). Associated palynomorphs (fossil spores) are likely to be found within unweathered, fine-grained, dark carbonaceous mudrock facies. Mudrock facies of the Baviaanskloof Formation are provisionally considered here to be of HIGH palaeosensitivity, unless highly weathered or cleaved.

The Late Caenozoic superficial deposits overlying the Table Mountain Group bedrocks in the project area are likely to be of low palaeosensitivity in the Plettenberg Bay region (*cf* Almond 2019). So far, substantial fossil remains do not seem to have been reported from the acidic Pleistocene **coversands**. Presumably all but the most robust vertebrate bones and teeth or mollusc shells here will have been destroyed by deep chemical weathering. At Simola, north of Knysna, Acheulian (Earlier Stone Age) stone artifacts were recorded from the base of a coversand profile, suggesting an age of less than 1.8 Ma (Holmes *et al.* 2007). Several comparable exposures of Pleistocene aeolianites featuring well-preserved embedded ESA and MSA stone artefacts are now known.

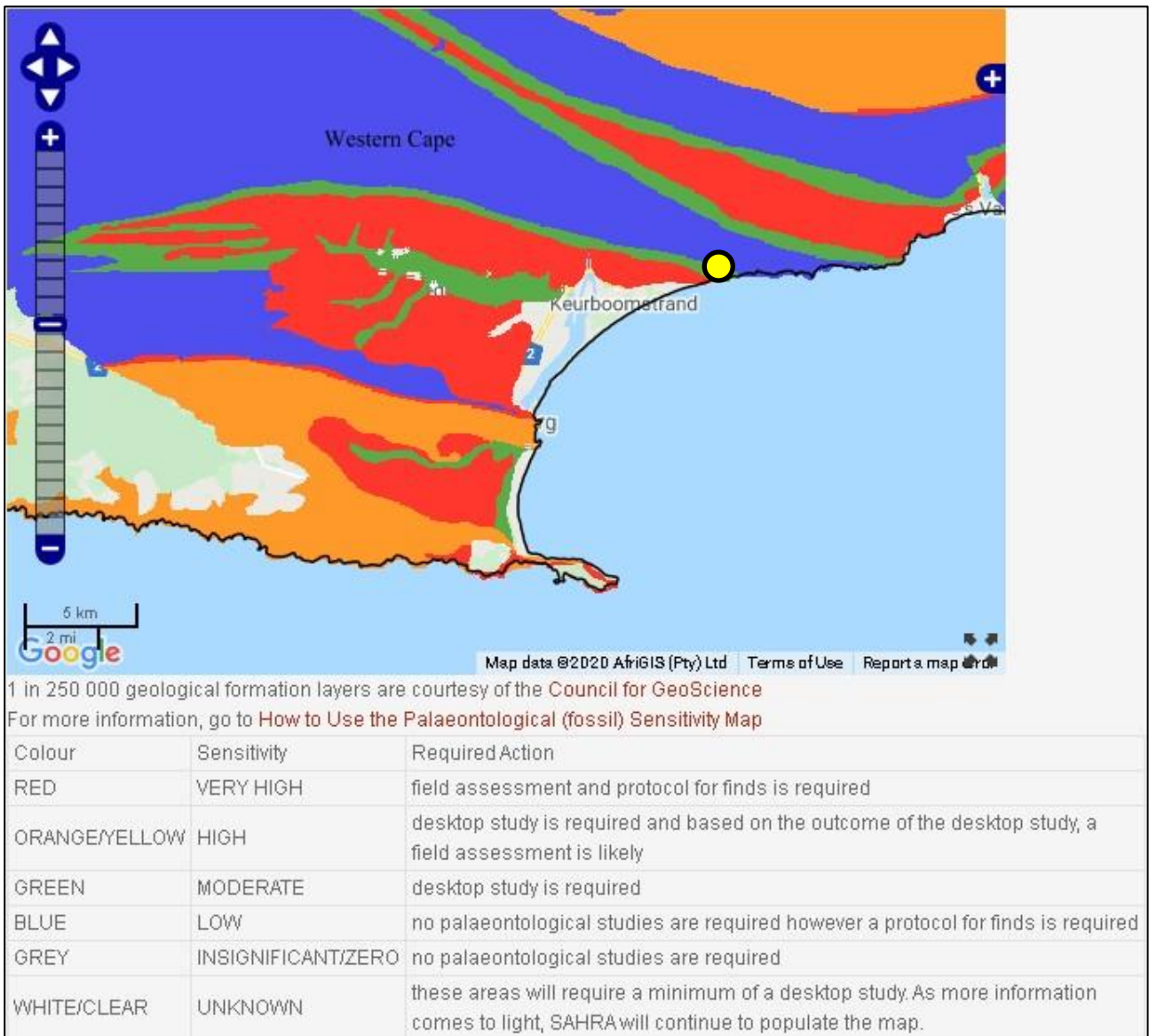
## 5. CONCLUSIONS & RECOMMENDATIONS

The project area for the proposed residential development on a Portion of Remainder of Erf 155, Keurboomstrand, is underlain by Early Devonian marine to coastal sediments of the Baviaanskloof Formation (uppermost Table Mountain Group). Elsewhere along the Southern Cape coast dark, organic-rich mudrocks within this formation contain important, largely unstudied fossils of primitive land plants while a small range of shelly invertebrate and trace fossils occur within sandstone facies in parts of the Western Cape. The overlying Late Caenozoic superficial sediments (colluvium, coversands, soils *etc*) are probably largely or entirely unfossiliferous.

The DEFF Screening Tool does not highlight the potentially high palaeosensitivity of the Keurboomstrand residential development project area while this is assigned a MEDIUM sensitivity on the SAHRIS Palaeosensitivity Map (Fig. 7). However, given (1) the demonstrated presence of dark grey mudrocks of the Baviaanskloof Formation, both at surface and within test pits within the project area, and (2) the potential of these mudrocks to contain scientifically valuable fossils, most notably primitive terrestrial plants, a precautionary approach is appropriate here. Pending a specialist palaeontological site visit, the bedrocks should be provisionally assigned a HIGH to VERY HIGH palaeosensitivity.

As a condition for Environmental Authorisation of the proposed development, it is recommended that a pre-construction site visit be made by a palaeontological specialist. This is to (1) record any near-surface fossil material and its geological context, (2) assess the site's palaeosensitivity and

potential impacts on fossil heritage posed by the development, and (3) make appropriate recommendations for any further palaeontological monitoring or mitigation measures (if any) to be taken in the pre-construction and / or construction phases. The specialist palaeontological field report should be submitted for comment to Heritage Western Cape (HWC contact details: Heritage Western Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za). All reporting should meet the minimum standards for palaeontological reports specified by HWC (2016).



**Figure 7: Extract from the SAHRIS Palaeosensitivity Map on the SAHRIS Website showing the Medium Sensitivity assigned to bedrocks in the Keurboomstrand residential development project area on the south coast near Plettenberg Bay (yellow circle). It is argued in this report that the project area should be provisionally assigned a HIGH palaeosensitivity pending a palaeontological specialist site visit.**





**Figure 8: Dark grey micaceous siltstones of possible lagoonal origin from the Baviaanskloof Formation of the Eastern Cape containing dense, multi-layered fossilised assemblages of primitive forking vascular plants (*Dutoitia*). The characteristic flared tips (arrowed) bear the reproductive organs (Specimens in collections of the Iziko Museums, Cape Town). The plant axes seen here bear tiny spinules and are 1-1.5 mm wide.**

## 6. ACKNOWLEDGEMENTS

Mr Jonathan Kingwill of Bluepebble Sustainability Solutions, Knysna is thanked for commissioning this study and for providing the necessary project information. Pertinent geological field data in the 2020 reports compiled by Outeniqua Geotechnical Services, Knysna, and Dr Peter Nilssen, Mossel Bay is much appreciated, as is Dr Nilssen's alert concerning the potential palaeosensitivity of the project site and the need for a palaeontological heritage study here.

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## 8. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Mpumalanga, Free State, Limpopo, Northwest and Kwazulu-Natal under the aegis of his Cape Town-based company *Natura*



Viva cc. He has been a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

### **Declaration of Independence**

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



**Dr John E. Almond**  
**Palaeontologist**  
***Natura Viva cc***